TEM characterization of NiGa model catalysts for methanol synthesis

Spiga, Cristiano; Almind, Mads Radmer; Secher, Niklas; Silva, Hugo José Lopes; Wagner, Jakob Birkedal; Chorkendorff, Ib; Damsgaard, Christian Danvad

Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

TEM characterization of NiGa model catalysts for methanol synthesis

C. Spiga[1, 2] , M.R. Almind[1,2], N. Secher[1,2], H.J.L. Silva[2], J.B. Wagner[1], I. Chorkendorff[2], C.D. Damsgaard*[1,2]

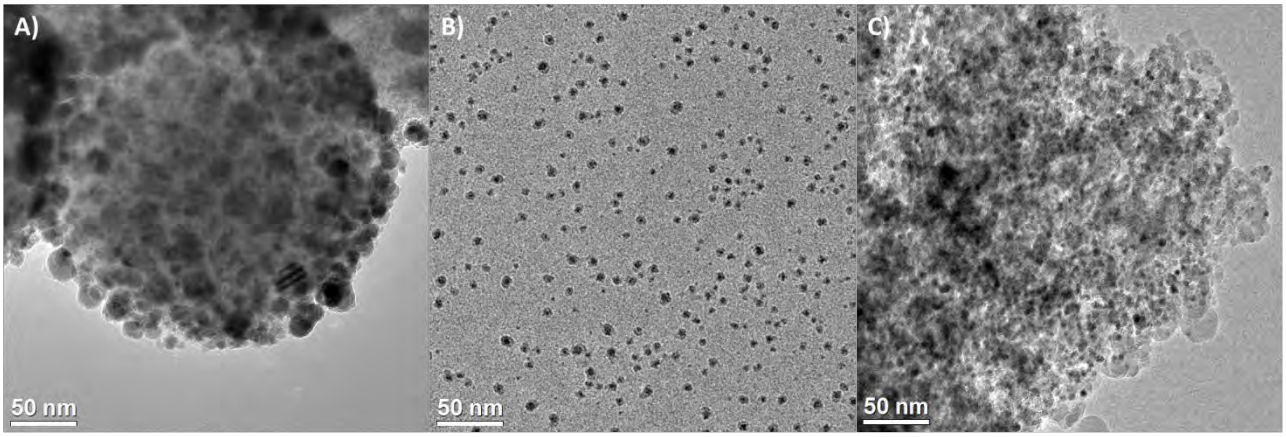
1: DTU Cen; 2: DTU Physics, *Corresponding author email: cdda@dtu.dk

Catalysis will play a crucial role in all technologies, which potentially could be used for producing sustainable chemical fuels from solar energy. One specific challenge concerns energy conversion based upon decentralized hydrogen production. One solution could be to store hydrogen on location by methanol synthesis under lower pressure conditions.

δ-Ni_5Ga_3 catalysts prepared by incipient wetness impregnation on a high surface area SiO_2 support, have shown comparable turn-over frequencies to the preferred commercial $Cu/Zn/Al_2O_3$ catalyst system[1-2]. The catalysts have been studied and characterized extensively by activity measurements, in situ XRD, and Environmental Transmission Electron Microscope (ETEM)[3] during nanoparticle formation, methanol synthesis[2], and accelerated aging experiments.

In order to optimize the catalyst even further the active state and de-activation mechanism should be determined. However, the morphology of the support may complicate interpretation of EM images of the catalyst on the atomic level due to limited depth of field. One way to circumvent this is to synthesize the NPs on a low surface area support representing the “real” high surface area SiO_2 supported catalyst.

This study presents synthesis and characterization of NiGa NPs supported on 200 nm SiO_2 spheres and SiO_2 membranes[4], respectively. By studying the structure-activity relationship of these model catalysts, we aim to identify catalytic active state and pre-dominant deactivation mechanisms that represent the behavior of the high surface area SiO_2 supported catalyst.



TEM micrographs of NiGa NPs supported on A) 200 nm SiO_2 spheres, B) SiO_2 membranes and C) High surface area SiO_2 support.

References:
[1] F. Studt et al., Nature Chemistry 6(2014), p. 320.
[2] I. Sharafutdinov et al., Journal of Catalysis, 320(2014), p. 77.
[3] T.W. Hansen et al., Materials Science and Technology 11(2010), p. 1338.
[4] C.D. Damsgaard et al., Microscopy 63(2014), p. 397.